Quality Assurance
Procedure QAP 5952

Method of Test For

CDOT Ultrasonic Procedure for Testing Welds Which Incorporated Permanent Back-Up Bars

1. PURPOSE

1.1 The purpose of this procedure is to define and supplement the AASHTO/AWS D1.5M/D1.5current edition ultrasonic testing criteria. The procedure shall be followed for testing butt welds with attached back-up bars.

2. SCOPE

2.1 This procedure meets the requirements of AASHTO/AWS D1.5M/D1.5current edition, however, it more specifically addends the Code, thus providing a more efficient detection and evaluation of weld flaws (while not needlessly reject welds based upon spurious geometrical signal misinterpretation). This procedure is limited to the examination of groove welds in butt joints which utilize permanent back-up bars (Back-up bars are not used in design Category C welds in Colorado. Shallow reflective cracks have been found to occur as frequently as 60% of the population; they are undetected by the Code ultrasonic, radiographic, and magnetic particle methods. The Magnetic Particle Inspection Procedure will detect these shallow cracks if the back-up bar is removed, or for excavation verification.

3. PERSONNEL

3.1 Personnel Qualifications

3.1.1 Contracted NDT for the CDOT shall use personnel qualified in accordance with their Written Practice which must meet SNT- TC-1A and which shall be reviewed and approved by CDOT.

3.1.2 Copies of the NDT personnel qualification records shall be submitted to the CDOT Bridge Construction Engineer for approval.

4. APPARATUS

4.1 Equipment outlined in Section 6 of D 1.5 shall be used as modified herein:
4.2 The testing frequency for initial scanning shall be 3.5 MHz.
4.3 The testing angle shall be selected in accordance with the following material thicknesses:

Thickness (inclusive)	Angle
5/16" - 3/8"	70
7/16" +	45*

* Planar indications shall require further evaluation with the 70 degree angle.

4.4 The transducer characteristics shall be established in accordance with the Procedure for Determining the Characteristics of an Ultrasonic Search Unit, QAP 5950. The entry point shall be accurately measured.

4.5 Acceptance evaluations shall be performed in accordance with the procedure outlined in Table 6.2 as applicable.

5. PROCEDURE

5.1 Joint Sketch and layout

5.1.1 The designated joint used and its exact location shall be established on the test specimen (Groove weld edges can be acid etched provided access is available. This accurately locates the center of the joint). The joint shall be sketched to scale on the test reference sheet. From the center of the root, the distance S (probe standoff) and R (distance range) are established (See Figure 1).

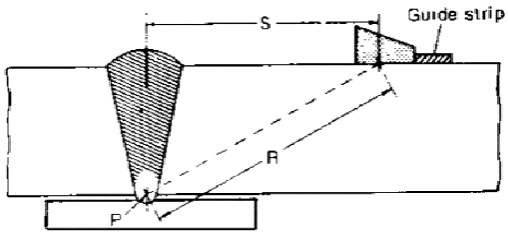

Figure 1

The theoretical sound path to the root (thickness of material = leg I), shall be established as follows:

$$\textit{Theoretical Soundpath} = \frac{\textit{Thickness}}{\textit{Cosine Test Angle}}$$

The horizontal distance shall be set at the leg I plus 1/2 inch.

5.1.2 From the standoff distance, S, add the distance from the search unit entry point to the heel of the search unit and mark this reference line on the test specimen.

5.2 Initial Scan

5.2.1 The search unit heel is placed with the heel located on the standoff line. The use of magnetic tape as a guide is helpful, allowing visual contact with the CRT while scanning. Scanning at a rate of less than 3 inches/second, move the search unit with the heel in contact with the guide tape.

5.2.2 Signal interpretation to distinguish flaw signals on the far side of the root from the fusion boundary at the back-up bar is difficult. The maximized signal from the flaw will appear to the right of the marked range R. Interpretation difficulties can also occur for flaws which are at, or immediately adjacent to the fusion boundary. Reflectors, especially cracks which often continue to the fusion boundary form ultrasonic

corner effect (amplitude by itself is meaningless). In this case the signal will begin to appear on the CRT at a longer sound path distance than the root, even though the maximized signal occurs at the root. Echoes returned from the root geometry are most often continuous while those from a flaw are intermittent. Mark any flaw indications for further evaluation (using the final scanning procedure).

Sound energy transmitted through the weld into the backup bar will produce recognized secondary reflections. These signals occur beyond the calculated Leg I distance.

5.3 A final scan shall be made with the guide tape removed or placed one inch behind the standoff line (determination of planar flaws mandates its removal). Using Section 6, D1.5 scanning patterns a, b, c combined into one movement, scan the entire volume of the weld and heat affected zone. Slight forward and backward movement from the standoff line shall be used to locate the source of the signal, i.e., an echo from the fusion zone of the back-up bar will decrease whichever direction the search unit is moved. A signal from a flaw in the upper portion of the beam boundary will increase in amplitude when the search unit is moved forward and decrease when it is moved back.

5.3.1 Signals at the required scanning sensitivity (D1.5) which: (1) increase to reference height as the transducer is moved toward the joint, and (2) appear at the established beam profile edge (the edge of the beam profile established , QAP 5950) 0.06 inches beyond the theoretical soundpath (4.1), shall be evaluated in accordance with paragraph 5.0.

6. ACCEPTANCE CRITERIA

6.1 Acceptance shall be determined in accordance with the requirements of Section 6 of AASHTO/AWS D1.5M/D1.5current edition.

7. RECORDS

7.1 All non-conformance test reports shall be made on a CDOT report.